# Psocoptera from Sleeping Nests of the Dusky-footed Wood Rat in Southern California ${ }^{1}$ <br> (Psocoptera: Atropidae, Psoquillidae, Liposcelidae) 

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A small collection of psocids from sleeping nests of the dusky-footed wood rat, Neotoma fuscipes Howell, in San Diego County, California, was sent to me by Mr. Tom Ashley of El Cajon, California. The material includes 21 specimens of four species, three of which are new to science and are here described. One of the new species is also represented in material received from Mr. R. F. Wilkey of the California Department of Agriculture, Sacramento. These records are also included.

Two of the new species belong to the genus Liposcelis, a group still little studied, though well represented, in North America. Badonnel has developed a classification of this genus in a series of papers (1962, 1963, 1967 , 1969), which I follow in this work.

The other new species is in the genus Rhyopsocus, and is a brachypterous species very similar to $R$. squamosus Mockford and Gurney (1956). Comparison requires a redescription of the latter species, the female of which has not previously been described and the male not in sufficient detail.

Details of the collecting data and occurrence of the species in each nest are presented in the text. Lepinotus reticulatus Enderlein, a species common in the arid regions of southwestern United States, is the species most frequently encountered in the rat nests. Only one species, Rhyopsocus micropterus Mockford, is represented by both sexes. This may be a question of sampling accident in case of both Liposcelis species, but Lepinotus reticulatus is parthenogenetic in North America.

It is of interest to note that two of the new species, Rhyopsocus micropterus Mockford and Liposcelis triocellatus Mockford, have greatly reduced compound eyes. This fact suggests the possibility that these species may be closely associated with rodent nests. The association is certainly not obligatory in the case of Liposcelis triocellatus, two records of which are from samples of ground litter and soil.

Several papers have documented the association of psocids with warmblooded vertebrates. Pearman (1960) recorded eight species of psocids

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collected on rats in Tanzania and one from St. Helena. The rat species involved were Rattus rattus (Linnaeus), R. rattus alexandrinus (Geoffroy Saint-Hilaire), and Mastomys natalensis (Smith). It should be noted that all but one of the species of psocids reported by Pearman are known from habitats not associated with rats. Badonnel (1969) listed two species of psocids, Liposcelis entomophilus Enderlein and L. bostrychophilus Badonnel, from the fur of mammals in Angola. Seven species of mammals were involved, five of them rodents, one an insectivore, and one a fissiped. Gurney (1950) cited records of psocids infesting the fur of chinchillas, puppies, and human hair. Mockford (1967) recorded psocids from plumage of five species of birds.

Records of psocids in the nests of birds have been cited by Hicks, Rapp, and Wlodarczyk (literature references in Mockford, 1967). Wlodarczyk and Martini (1969) have studied quantitatively the occurrence of psocids in bird nests in the Lodz Uplands of Poland.

Four species of psocids (three of Liposcelis) were recorded from a nest of a tree mouse, Dendromus mysticallis ansorgei Thomas and Wroughton, and one (also a Liposcelis) from the nest of a lemuroid primate, Galago demidovi phasma Cabrera and Ruxton, in Angola by Badonnel (1969). Psocids are probably much more common in the nests both of birds and mammals than the scanty literature records suggest.

Measurements for the new species are presented in Tables 1 and 2. Abbreviations used in connection with the measurements are explained as follows:

> Post. tib. = posterior tibia.
> Post. tars. $\mathrm{t}_{1}$, etc. = first posterior tarsomere, etc.
> Ant. $\mathrm{f}_{1}$, etc. = first flagellar segment, etc.
> Ant.-Post. eye diam. = antero-posterior eye diameter.
> $\mathrm{IO} / \mathrm{D}=$ smallest distance between compound eyes divided by greatest anteroposterior diameter of compound eye in dorsal view.
> $\mathrm{PO}=$ transverse diameter of compound eye in dorsal view divided by greatest antero-posterior diameter of eye in same view.
> $\mathrm{Mx}$. plp. seg. $4=$ distal segment of maxillary palpus.
> Post. tr. = posterior trochanter (measured with femur in Liposcelis).
> $\mathrm{S}_{\mathrm{I}}=$ the longest seta of the lateral margin of the pronotum.
> $\mathrm{S}_{\mathrm{II}}=$ the longest antero-lateral marginal seta of the mesonotum.
> $\mathrm{Md}_{\mathrm{I}}=$ the longest lateral seta of the ninth abdominal tergum.
> $\mathrm{Se}=$ the longest seta of the epiproct.

Photomicrographs were made by Dr. David Weber of the Department of Biological Sciences, Illinois State University, using a Zeiss Photomicroscope II. For the sculpture of the cuticle of the Liposcelis species,
phase-contrast microscopy, a $40 \times$ oil immersion lens, and high contrast film were used. Specimens were prepared for photography of the cuticle by clearing in hot $8 \% \mathrm{KOH}$ solution, staining in a saturated solution of light green in $95 \%$ ethyl alcohol, and mounting in euparal.

## Family Atropidae

## Lepinotus reticulatus Enderlein

This species is represented by eleven adult females in three nests. It has an extremely wide range (all continents) and has been captured on the plumage of living birds (Mockford, 1967).

Records.-San Diego County, California, T. Ashley collector: Cuyamaca Reservoir, 15 April 1968, nest No. 0-12F7-6, 2 q; 5 miles south of Lakeside, 16 April 1968, nest No. 0-12B9-14, 3 ¢ ; Dulzura, 22 April 1968, nest No. 0-12W12-15, 6 ㅇ.

## Family Psoquillidae

## Rhyopsocus micropterus Mockford, new species

Diagnosis.-Brachypterous. Differing from the other known brachypterous species, R. squamosus Mockford and Gurney, primarily in following features:

1) Compound eye size and number of facets:-much smaller eye with fewer facets in this species; 2) Distal segment of maxillary palpus:decidedly clavate in $R$. squamosus, much less so in this species; also, lateral sensilla of this segment differing (Fig. 4 vs. Fig. 9) ; 3) Shape of distal end of hypandrium, it being slightly bilobed in R. squamosus (Fig. 10) and rounded in this species (Fig. 7) ; 4) Shape of tips of external parameres ( $=$ porifers), these being bent in $R$. squamosus (Fig. 11) and curved in this species (Fig. 14) ; 5) Sclerite of orifice of spermathecal duct, it being heavier in $R$. squamosus than in this species (Fig. 13 vs. Fig. 15) ; 6) Shape of accessory bodies of spermatheca, ${ }^{2}$ the sides being approximately parallel in $R$. squamosus and one side being indented, producing a bean-shaped structure in this species.

Male and Female.-Measurements.-(Table 1). Morphology.-Forewings extending to just short of half length of abdomen ( $\hat{\delta}$ ), just beyond one-third length of abdomen ( Q ). Hindwings about one-third length of forewings. Epicranial suture present; frontal sutures absent ( $\%$ ), present but faint in $\hat{\delta}$. Ocelli absent, their places marked by three minute brown spots in cuticle anterior to epicranial

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Figs. 1-10. Figs. 1-7, Rhyopsocus micropterus Mockford, n. sp.: Fig. 1. 오, forewing; Fic. 2. 우, head in anterior view; Fig. 3. $\widehat{8}$, compound eye; Fig. 4. ㅇ, distal segment of maxillary palpus; Fig. 5. ̂̀, distal segment of maxillary palpus; Fig. 6. lacinial tip (L indicates lateral tyne) ; Fig. 7. ̂̂, hypandrium. Figs. 8-10, Rhyopsocus squamosus Mockford and Gurney: Fic. 8. ㅇ, compound eye; Fic. 9. ㅇ, distal segment of maxillary palpus; Fig. 10. ô, hypandrium. Scale of Fig. 2 also applies to Figs. 3 and 8; scale of Fig. 4 also applies to Figs. 5 and 9; scale of Fig. 7 also applies to Fig. 10. Scales are in mm.
suture. Distal segment of maxillary palpus slightly clavate. Pronotum beset with transverse row of long, backward-directed curved setae. Mesonotum roughly triangular with base anterior; showing no trace of divisions into notal lobes. Metanotum with scutellum distinct. Color (in alcohol; sexes same).-Compound eyes

|  | Forewing length | Post. tib. length | Post. tars. $\mathrm{t}_{1}$ length | Post. tars. $\mathrm{t}_{2}$ length | Post. tars. <br> $\mathrm{t}_{3}$ length | Ant. $\mathrm{f}_{1}$ length | Ant. $\mathrm{f}_{2}$ length | Ant. $\mathrm{f}_{3}$ length | Ocular Interval | nt.-Pos Eye Diam. | Io | PO |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| R. squamosus |  |  |  |  |  |  |  |  |  |  |  |  |
| ¢ | 0.47 | 0.44 | 0.18 | 0.06 | 0.05 | 0.07 | 0.05 | 0.06 | 0.27 | 0.15 | 1.79 | 0.67 |
| ¢ | 0.63 | 0.48 | 0.19 | 0.05 | 0.05 | 0.07 | 0.04 | 0.07 | 0.31 | 0.16 | 1.96 | 0.68 |
|  | 0.51 | 0.44 | 0.17 | 0.06 | 0.05 | 0.07 | 0.04 | 0.06 | 0.29 | 0.16 | 1.88 | 0.60 |
| R. micropterus |  |  |  |  |  |  |  |  |  |  |  |  |
| ิ | 0.61 | 0.46 | 0.18 | 0.04 | 0.05 | 0.07 | 0.04 | 0.05 | 0.31 | 0.03 | 3.85 | - |
| 아 | 0.52 | 0.44 | 0.19 | 0.05 | 0.05 | 0.07 | 0.04 | 0.06 | 0.33 | 0.08 | 4.08 | - |



Figs. 11-18. Figs. 11-13, Rhyopsocus squamosus Mockford and Gurney: Fig. 11. ${ }^{\star}$, phallosome; Fig. 12. ${ }^{\text {a }}$, paraproct; Fig. 13. , , sclerite of spermathecal orifice. Figs. 14-18, Rhyopsocus micropterus Mockford, n. sp.: Fig. 14. ô, phallosome; Fig. 15. ㅇ, spermathecal duct and accessory bodies; Fig. 16. ô, paraproct; Fig. 17. ㅇ, sclerite of spermathecal orifice; Fig. 18. ㅇ, gonapophyses. Scale of Fig. 11 also applies to Fig. 14; scale of Fig. 12 also applies to Fig. 16; scale of Fig. 17 also applies to Fig. 13. Scales are in mm.


Figs. 19-26. Figs. 19-25, Liposcelis villosus Mockford, n. sp., 우: Fig. 19. prosternum; Fig. 20. chaetotaxy of mesosternum; Fig. 21. stem of gonapophyses; Fig. 22. T-shaped sclerite; Fig. 23. habitus, dorsal view; Fig. 24. lacinial tip; Fig. 25. chaetotaxy of pronotum and anterior edge of mesonotum. Fic. 26, Liposcelis triocellatus Mockford, n. sp., ㅇ, stem of gonapophyses. Scale of Fig. 20 also applies to Fig. 19; scale of Fig. 21 also applies to Fig. 22; scale of Fig. 26 also applies to Fig. 24. Scales are in mm.
black. Head, thorax, and forewings pale tawny-brown. Legs and antennae somewhat paler. Abdomen with colorless cuticle, the internal structures showing through, producing a yellowish-white appearance.

Holotype male, and allotype, 5 miles south of Lakeside, San Diego County, California, 16 April 1968, in nest of Neotoma fuscipes (nest No. 0-12B9-14), collected by T. Ashley. Types are in my collection.

## Rhyopsocus squamosus Mockford \& Gurney

Male.-Hypandrium (Fig. 10) bearing a pair of lobes of low relief on its distal margin. Phallosome (Fig. 11): lateral struts (parameres of authors, paraphallia of Pearman, 1961) somewhat widened near their bases; the external (pore-bearing) distal branches of the struts (external parameres of authors, porifers of Pearman, 1961) bent inward near their apices. Paraproct (Fig. 16) with two or three trichobothria with distinct basal florets.
Female.-Measurements.-(Table 2). Morphology.-Brachypterous; wings relatively slightly shorter than in male, the forewings reaching from just beyond onethird to just short of half length of abdomen. Epicranial and frontal sutures present, the latter faintly developed. Ocelli small but visible on cleared head. Terminal segment of maxillary palpus clavate (Fig. 9) with 2 lateral sensilla in form of sensory hairs, thicker and with larger follicles than surrounding hairs. Compound eyes as in male, large and with many facets (Fig. 8). Gonapophyses developed as in R. micropterus. Accessory bodies of spermatheca (Fig. 39) lacking lateral indentations. Sclerite of spermathecal orifice (Fig. 13) decidedly thickened at apex. Color (in alcohol).-Essentially as for male; both specimens showing faint purple subcuticular annulations on all preclunial abdominal segments.

Material.-Bentsen Rio Grande Valley State Park, Hidalgo County, Texas, 28 January 1958, l 九, 3 오, E. L. Mockford collector.

## Family Liposcelidae

## Liposcelis villosus Mockford, new species

Diagnosis.-Species of Section I, Group A, subgroup Ab of Badonnel (1962, 1963, 1967), close to L. castrii Badonnel, L. nasus Sommerman, the complex L. discalis-reticulatus-laparvensis, Badonnel, L. hirsutus Badonnel, L. distinctus Badonnel, and L. puber Badonnel. Differing from $L$. castrii and $L$. nasus in details of coloration, being apparently darker than both, and in possession of larger number of setae on prosternum. Differing from the complex L. discalis-reticulatus-laparvensis: from all by absence of fine reticulate pattern on abdominal intersegmental membranes; from each species by details of coloration (this species without dark mark along anterior margins of abdominal segments 7 and 8). Differing from L. hirsutus by lack of truncated setae on abdominal terga 3-7. Differing from L. puber in details of coloration and from $L$. distinctus in sculpture of vertex.
Table 2. Measurements (in mm.) of specimens of Liposcelis triocellatus Mockford and L. villosus Mockford. Figures



Figs. 27-34. Fig. 27, Liposcelis villosus Mockford, n. sp., + , chaetotaxy of abdominal terga 8-11. Figs. 28-34, Liposcelis triocellatus Mockford, n. sp., ㅇ: : Fig. 28. lacinial tip; Fic. 29. T-shaped sclerite; Fig. 30. chaetotaxy of abdominal terga 8-11; Fig. 31. compound eye (arrow indicates anterior direction) ; Fic. 32. chaetotaxy of pronotum and anterior margin of mesonotum; Fig. 33. prosternum; Fig. 34. chaetotaxy of mesosternum. Scale of Fig. 32 also applies to Figs. 33 and 34. Scales are in mm.

Female.-Measurements.-(Table 2). Morphology.-Median suture of vertex absent. Thoracic parapsidal sutures not visible. Lacinial tip (Fig. 24). First abdominal tergum with a single sclerotized area. Common trunk of gonapophyses (Fig. 21), rather narrow basally. T-shaped sclerite of subgenital plate (Fig. 22) with expanded area around base of stem. Sculpture.- vertex (Fig. 36) with small, slender, transversely oriented arcoles separated by depressed lines and bearing exceedingly minute granulations visible with phase-contrast microscopy. Abdominal terga: first tergum with very distinct transverse clear lines separating narrow areoles bearing finc granulations. Remaining terga (Fig. 35 of 5th tergum) bearing broader areoles covered with much larger granules, each granule clear in its center. Chaetotaxy.-hairs of vertex sparse, long (about $24 \mu$ ), generally shorter than distances between them, but near epistomal suture distances less than hair lengths. Prothorax with $\mathrm{S}_{\mathrm{I}}$ long, one other long seta along anterior margin of each lateral lobe, and two long setae along anterior margin of median lobe near its lateral edges; a few scattered small setae more posteriorly. Prosternum bearing 10 setae arranged in a U-shaped curve. Synthorax (Figs. 20, 25) with $\mathrm{S}_{\text {II }}$ about same length as $\mathrm{S}_{\mathrm{r}}$, two other long setae along its anterior margin, and several shorter setae scattered over its dorsal surface; mesosternal row of 9 long setae. Setae of abdominal terga sparse, very variable in length; first tergum with single transverse row of setae; terga $2-7$ each with a transverse row and several scattered setae anterior to this. Setae of abdominal terga 8-10 (Fig. 27). Color (in alcohol). -Compound eyes black. Head reddish-brown, decidedly darker on clypeus than on vertex and frons. Subcutaneous red pigment granules scattered on vertex and frons, concentrated somewhat along epicranial and frontal sutures, and, more strongly around antennal sutures. Thorax, abdomen, and legs medium brown with slight reddish hue. Abdomen dorsally with narrow purple band bordering each intersegmental membrane between abdominal segments $1-2,2-3,3-4,4-5$, and $5-6$, the first two rather faint. A narrow, colorless posterior membranous area present on abdominal segments 6 and 7.

Holotype female, Cuyamaca Reservoir, San Diego County, California, 15 April 1968, in nest of Neotoma fuscipes (nest No. 0-12F7-6), T. Ashley collector. One $\circ$ paratype, same data as type. Types are in my collection.

## Liposcelis triocellatus Mockford, new species

Diagnosis.-A species of Section I, by absence of posterior membranous regions on abdominal terga 3 and 4 , and of Group B by having the humeral seta of only medium length and lacking an anterior transverse row of setae on each lateral lobe of pronotum. Differing from all other members of this group by possession of only 3 ocelloids in each compound eye.
Female.-Measurements.-(Table 2). Morphology.-Median suture of vertex recognizable for short distance as an irregular break in sculpture. Thoracic parapsidal sutures recognizable only as bands of tuberculate sculpture bordered by empty areoles. Lacinial tip (Fig. 28) with denticles strongly diverging. First abdominal tergum divided into three sclerotized areas: one anterior and two pos-


Figs. 35-39. Figs. 35 and 36, Liposcelis villosus Mockford, n. sp., 오: Fig. 35. fifth abdominal tergum showing sculpture of integument; Fig. 36. central region of vertex showing sculpture of integument. Figs. 37 and 38. Liposcelis triocellatus Mockford, n. sp., $\quad$; Fig. 37. central region of vertex showing sculpture of integument; Fig. 38. regions of abdominal terga 3 and 4 bordering intersegmental line, showing sculpture of integument. Fig. 39, Rhyopsocus squamosus Mockford and Gurney, $\mathscr{P}$, spermatheca with its accessory bodies, duct, and sclerite of the orifice.
terior. Common trunk of gonapophyses (Fig. 26) elongate, narrow basally. Tshaped sclerite of subgenital plate (Fig. 29). Sculpture.—vertex (Fig. 37) with roughly polygonal areoles, their long axes mostly oriented transversely, separated by depressed lines, and bearing numerous granulations. Abdominal terga: sclerotized areas beset with large, irregular granules oriented in some areas into transverse areoles narrowly separated by lines. The areoles much better developed posterior to segment 4 than anterior to it. On membranous portions of terga 5-7, granules much smaller than anteriorly, becoming increasingly smaller posteriorly and replaced by transverse lines immediately anterior to posterior border of each segment. Chaetotaxy.-hairs of vertex gencrally shorter than distances between hairs, the hairs about $9 \mu$ in length. Prothorax (Figs. 32, 33) with $S_{\text {I }}$ of medium length; other dorsal setae few, somewhat shorter than $S_{\mathrm{I}}$. Three prosternal setae. Synthorax (Figs. 32, 34) with $S_{\text {II }}$ about same length as $S_{1}$; other setae generally shorter, sparse; two setae on parapsidal suture of each side; mesosternal row of 6 setae. Abdominal setae oriented in distinct transverse rows on terga 1 and 2 , with one row per tergum; on tergum 3 a distinct anterior and a distinct posterior row with several setae scattered between; more posteriorly row orientation absent, setae scattered; setae on anterior terga about $8 \mu$ in length. Terminal abdominal setae (Fig. 30) ; epiproct with 2 straight setae much longer than others. Color (in alcohol).-Compound eyes black; body and appendages pale straw-brown dorsally, somewhat paler ventrally.

Holotype female, Cuyamaca Reservoir, San Diego County, California, 15 April 1968, in nest of Neotoma fuscipes (nest No. 0-12F7-6), T. Ashley collector. Two $\&$ paratypes, same data as type. Same locality, situation, and collector, 22 May 1968, $3 \circ$ paratypes. Types are for the present in my collection.

Other records.-California: Los Angeles County, 2 miles south of Pearblossum, 31 March 1959, ex litter and soil (sandy loam) under Cupressus Macnabiana Murray along base of hills, F. C. Raney collector, 21 우 Kern County, 11 miles northeast of Caliente, 31 March 1959, ex litter and soil under Pinus Sabiniana Douglas, F. C. Raney collector, 10 우.

Discussion.-This species is probably most closely related to L. kidderi (Hagen) ( $=$ L. simulans race A Broadhead according to Pearman, 1951), which has only 5 to 6 ommatidia in the compound eye. It is similar in size and chaetotaxy to $L$. kidderi, but is closer to L. simulans (race B) Broadhead in sculpture of the abdominal terga. It is paler in color than L. kidderi or L. simulans. The three previously known species with greatly reduced number of ommatidia, L. paetus Pearman, L. paetulus Broadhead, and L. parvulus Badonnel, belong to Section II.

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All figures showing sculpture of integument are oriented with the anterior direction upward. Upper scale applies to Figs. 35, 36, 37, and 38; lower scale applies to Fig. 39. Scales are in mm.

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# Five New Species of Mordellidae from Louisiana and Mississippi ${ }^{1}$ 

(Coleoptera)
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This study was based on specimens sorted from light-trap collections received from the Gulf Coast Mosquito Control Commission, Gulfport, Miss., and the Mississippi Test Support Facility, NASA. The identification is based on Brimley (1951), following Liljeblad's classification (1945). The new species belong to the genus Mordellistena Costa. Their types are mounted in polyvinyl alcohol and deposited in the U. S. National Museum.

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[^0]:    ${ }^{1}$ Some materials used in this study were provided by a National Science Foundation grant, NSF GB-7729, to Illinois State University.

[^1]:    ${ }^{2}$ Term coined by Pearman (1931). Badonnel (1949) suggests the possibility that they may be homologs of the spermathecal maculae of Atropidae. Such a homology seems likely in view of presence of inward-directed double spines on the pores of these bodies in $R$. micropterus and $R$. squamosus, similar to the spines of the spermathecal maculae of Lepinotus inquillinus Heyden (personal observation).

[^2]:    ${ }^{1}$ This investigation was supported by an Academic Grant from Loyola University.

